3/20/18 "Failing to prepare, is preparing to fail."-Anonymous

HW: "Shifting Functions" Homework section

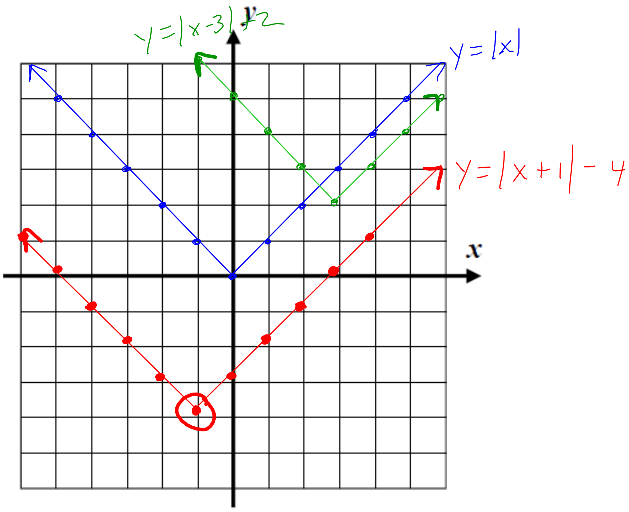
AIM: How do we identify shifts of functions?

Warm Up:

Exercise #1 part (a) on the handout

***Exercise* #1:** Consider the functions $y=|x|$, $y=|x-3|+2$ and $y=|x+1|-4$.

(a) Without the use of your calculator, graph $y=|x|$ on the axes provided. Label its equation.



(b) Using your calculator to generate a table of values, graph the other two absolute value functions above and label each with its equation.

(c) How would the graph of $y=|x|$ be shifted in order to produce the graph of $y=|x-6|-8$?

Shift right 6

down 8

inside affect x-values (left/right)

(*) Circle the original function:

1) Anything inside the circle we do the opposite to the x-values.

2) Anything outside of that circle we are doing exactly what it says to the y-values.

VERTICAL AND HORIZONTAL SHIFTING

Up/Down

1. **Vertical Shifting**: The function $f(x)+k$ shifts the function up by $|k|$ units for $k>0$ and down $|k|$ units for $k<0$. Do this to y-values

Left/Right

2. **Horizontal Shifting**: The function $f(x+k)$ shifts the function left $|k|$ units for $k>0$ and right $|k|$ units for $k<0$. Do opposite to x-values

***Exercise* #2:** The function $f(x)$ is shown on the grid below. A second function, g, is defined by $g(x)=f(x-3)+1$. up 1 right 3

(a) What is the value of $g(0)$? Show how you arrived at your answer.

$g(0)=2$

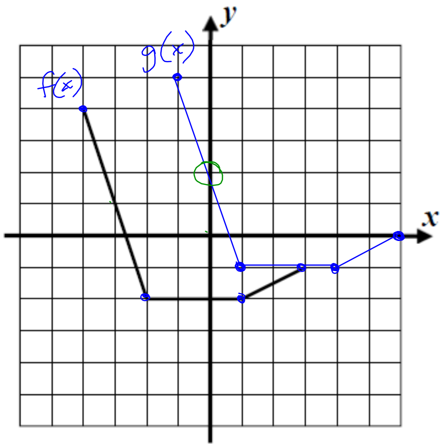
Alt:

$g(0)=f(0-3)+1$

$=f(-3)+1$

$g(0)=1+1$

$g(0)=2$



(b) Identify how the graph of f has been transformed to produce the graph of g and sketch it on the grid.

Shift right 3 and up 1

We can use these shifting patterns in a variety of ways because they apply to all types of functions.

***Exercise* #3:** A function, $f(x)$, has a domain of $-3 \le x \le 10$ and a range of $y \le 22$. What are the domain and range of the function $f(x+7)+10$? Explain how you arrived at your answers.

Inside so subtract 7 from x-values

Outside Add 10 to y-values

Domain $f(x)$ $-3 \le x \le 10$
$-7 \quad -7$

Domain $f(x+7)+10$ $\boxed{-10 \le x \le 3}$

Range $f(x)$ $y \le 22$
$+10$

Range $f(x+7)+10$ $\boxed{y \le 32}$

Recognizing shifts of other, simpler functions can help us identify prominent characteristics and compare them. The location of turning points is especially helpful.

Subtract 5 from y.

***Exercise* #4:** Given the quadratic function $f(x)=(x-4)^2-5$ answer the following questions.

(a) How has the simple quadratic $y=x^2$ been shifted to produce the graph of $f(x)$?

Right 4 units

Down 5 units

Add 4 to x

(b) Given that $y=x^2$ has a turning point at the origin, $(0,0)$, where must the turning point of f lie?

vertex

$$\begin{array}{c}(0,0)\\ +4\ \ -5\\ \hline \boxed{4,-5}\end{array}$$

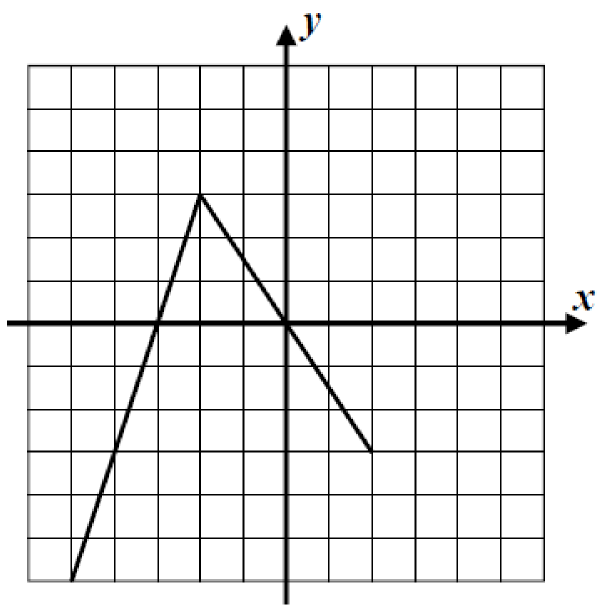
(c) Sketch f below and give the domain interval over which f is increasing.

(d) Which has a lower minimum value, the function f or the function $g(x)=|x-6|-10$? Explain your choice.

One of the hardest things for students to grasp is the horizontal shift, which appears to work opposite of what we would expect. Let's take a look at a shift that is purely horizontal.

***Exercise* #5:** The graph of $f(x)$ is shown below. The function $g(x)$ is defined by $g(x)=f(x-2)$.

(a) Show that $x=-1$ and $x=2$ are zeroes of the function g.



(b) Evaluate each of the following using the definition of g and then create a plot of g on the same set axes.

$g(-3)=$ $g(0)=$ $g(4)=$